

## VU Research Portal

### **Lateral epicondylitis in general practice: Course and prognostic indicators of outcome**

Smidt, N.; Lewis, M.; van der Windt, D.A.W.M.; Hay, E.M.; Bouter, L.M.; Croft, P.

#### ***published in***

Journal of Rheumatology  
2006

#### ***document version***

Publisher's PDF, also known as Version of record

[Link to publication in VU Research Portal](#)

#### ***citation for published version (APA)***

Smidt, N., Lewis, M., van der Windt, D. A. W. M., Hay, E. M., Bouter, L. M., & Croft, P. (2006). Lateral epicondylitis in general practice: Course and prognostic indicators of outcome. *Journal of Rheumatology*, 33(10), 2053-2059.

#### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

#### **Take down policy**

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

#### **E-mail address:**

[vuresearchportal.ub@vu.nl](mailto:vuresearchportal.ub@vu.nl)



\*All trademark rights used under license  
© 2011 JANSSEN Inc.  
19 Green Belt Drive  
Toronto, ON M3C 1L9  
[www.janssen.ca](http://www.janssen.ca)

Member  
PAB (R&D)  
SPEA110525E

janssen

PHARMACEUTICAL COMPANIES  
of Johnson & Johnson

# The Journal of Rheumatology

The Journal of Rheumatology

Volume 33, no. 10

Lateral epicondylitis in general practice: course and prognostic indicators of outcome.

Nynke Smidt, Martyn Lewis, Daniëlle A W M VAN DER Windt, Elaine M Hay, Lex M Bouter and Peter Croft

J Rheumatol 2006;33;2053-2059

<http://www.jrheum.org/content/33/10/2053>

1. Sign up for our monthly e-table of contents  
<http://www.jrheum.org/cgi/alerts/etoc>
2. Information on Subscriptions  
<http://jrheum.com/subscribe.html>
3. Have us contact your library about access options  
[Refer\\_your\\_library@jrheum.com](mailto:Refer_your_library@jrheum.com)
4. Information on permissions/orders of reprints  
<http://jrheum.com/reprints.html>

*The Journal of Rheumatology* is a monthly international serial edited by Duncan A. Gordon featuring research articles on clinical subjects from scientists working in rheumatology and related fields.

# Lateral Epicondylitis in General Practice: Course and Prognostic Indicators of Outcome

NYNKE SMIDT, MARTYN LEWIS, DANIELLE A.W.M. VAN DER WINDT, ELAINE M. HAY, LEX M. BOUTER, and PETER CROFT

**ABSTRACT.** *Objective.* To investigate the course of lateral epicondylitis and identify prognostic indicators associated with short- and longterm outcome of pain intensity.

*Methods.* We prospectively followed patients (n = 349) from 2 randomized controlled trials investigating conservative interventions for lateral epicondylitis in primary care. Uni- and multivariate linear regression analyses were used to investigate the association between potential prognostic indicators and pain intensity (0-100 point scale) measured at 1, 6, and 12 months after randomization. Potential prognostic factors were duration of elbow complaints, concomitant neck pain, concomitant shoulder pain, previous elbow complaints, baseline pain scores, age, gender, involvement of dominant side, social class, and work status. The variables "study" and "treatment" were included as covariates in all models.

*Results.* Pain scores at 1 month followup were higher in patients with severe pain, a long duration of elbow complaints, and concomitant shoulder pain. At 12 month followup, the only different prognostic indicator for poor outcome was concomitant neck pain, in place of shoulder pain. Patients from higher social classes reported lower pain scores at 12 month followup than patients from lower social classes.

*Conclusions.* Lateral epicondylitis seems to be a self-limiting condition in most patients. Long duration of elbow complaints, concomitant neck pain, and severe pain at presentation are associated with poor outcome at 12 months. Our results will help care providers give patients accurate information regarding their prognosis and assist in medical decision-making. (First Release Aug 1 2006; J Rheumatol 2006;33:2053-9)

*Key Indexing Terms:*  
TENNIS ELBOW  
PROGNOSIS

RANDOMIZED CONTROLLED TRIAL  
PRIMARY HEALTH CARE

Lateral epicondylitis or tennis elbow is a common, painful condition characterized by pain at the lateral side of the elbow, that increases during gripping or squeezing. The annual incidence of tennis elbow in general practice is between 4 and 7 per 1000 patients, with a peak between 35 and 54 years of age<sup>1-4</sup>, and it usually affects the dominant arm<sup>2,5,6</sup>. Lateral epicondylitis seems to be a self-limiting condition with an average duration of a typical episode between 6 months and 2 years<sup>7-9</sup>.

For management of patients with lateral epicondylitis in general practice, knowledge regarding its clinical course and

prognostic indicators of outcome is necessary. Hudak, *et al*<sup>8</sup> systematically reviewed available evidence on the clinical course of lateral elbow pain and prognostic factors that affect elbow pain duration and outcome<sup>8</sup>. Moderate evidence from 4 studies indicated that site of the lesion and prior occurrence are predictive of poorer outcome in patients with a clinical diagnosis of lateral epicondylitis<sup>10-13</sup>. Insufficient evidence was found to suggest that age, compliance with rest, pre-intervention pain scores, gender, or hand/arm dominance are predictive of outcome<sup>8</sup>.

Since the Hudak, *et al*<sup>8</sup> review, a few additional prognostic studies among patients with lateral epicondylitis have been carried out in general practice<sup>14,15</sup>.

Haahr and Andersen investigated prognostic factors, including demographic, work, and clinical characteristics in 266 patients with a new episode of lateral epicondylitis in general practice<sup>14</sup>. They found high baseline scores, manual work, high level of physical strain at work, high baseline distress, and involvement of the dominant side were associated with less pain reduction after 1 year followup<sup>14</sup>. The UK members of our team evaluated the persistence of lateral epicondylitis during a 12 month followup in general practice<sup>15</sup> and found that manual workers had higher pain scores during followup than non-manual workers. High baseline pain scores were also strongly associated with elbow pain during followup<sup>15</sup>. Although different methods were used, both studies

---

From the Institute for Research in Extramural Medicine, VU University Medical Center, Amsterdam, The Netherlands and the Primary Care Science Research Centre, Keele University, Keele, Staffordshire, United Kingdom.

Supported by The Netherlands Organization for Scientific Research (NWO) and the North Staffordshire Primary Care Research Consortium.

N. Smidt, PhD, Lecturer in Clinical Epidemiology, VU University Medical Center; M. Lewis, PhD, Senior Lecturer in Biostatistics, Keele University; D.A.W.M. van der Windt, PhD, Reader in General Practice Epidemiology, VU University Medical Center; E.M. Hay, PhD, Professor of Community Rheumatology, Keele University; L.M. Bouter, PhD, Professor in Clinical Epidemiology, VU University Medical Center; P. Croft, PhD, Professor in Primary Care Epidemiology, Keele University.

Address reprint requests to Dr. N. Smidt, Department of Clinical Epidemiology & Biostatistics, Academic Medical Center, University of Amsterdam, PO Box 22700, 1100 DE Amsterdam, The Netherlands.  
E-mail: n.smidt@amc.uva.nl

Accepted for publication May 2, 2006.

---

Personal non-commercial use only. The Journal of Rheumatology Copyright © 2006. All rights reserved.

found that manual work and high baseline scores were associated with poor outcome<sup>14,15</sup>.

Our aim was to describe the clinical course of lateral epicondylitis in general practice and to identify prognostic indicators of outcome in terms of pain at 1, 6, and 12 month followup.

## MATERIALS AND METHODS

**Study design.** For this prospective followup study, data of 2 large randomized controlled trials (RCT) were used<sup>16,17</sup>. We previously explored differences in the 2 study populations and for this analysis we combined them<sup>18</sup>. Hay, *et al* investigated the effectiveness of local injection of 20 mg methylprednisolone plus lignocaine (n = 53), naproxen 500 mg twice daily for 2 weeks (n = 53), and placebo tablets (n = 58) in patients with a new episode of lateral epicondylitis<sup>16</sup>. In the randomized controlled trial of Smidt, *et al*, patients with lateral epicondylitis were randomly allocated to either a local injection of 10 mg triamcinolone acetonide and lidocaine (n = 62), physiotherapy consisting of deep friction massage, pulsed ultrasound, and an exercise program (n = 64), or a wait-and-see policy (n = 59) including ergonomic advice and pain medication if necessary<sup>17</sup>. In both studies, patient characteristics and potential prognostic indicators were assessed at the initial visit.

**Inclusion and exclusion criteria.** The sample represented 2 cohorts of consecutive patients who consulted their general practitioner (GP) for elbow pain. In total 83 general practices participated in this study, 23 general practices (37 GP) in North Staffordshire and South Cheshire in the UK, and 60 general practices (85 GP) in Amsterdam, Amstelveen, Alkmaar, Purmerend, and Haarlem in The Netherlands. The following inclusion criteria applied in both studies: clinical diagnosis of lateral epicondylitis; age between 18 and 70 years; ability to fill in questionnaires, and informed consent. Exclusion criteria were a history of inflammatory arthritis or gross structural abnormality of the elbow; contraindication to nonsteroidal antiinflammatory drugs (NSAID) or local steroid injection; pregnancy or breast feeding; presence of signs and symptoms suggesting some other cause of lateral elbow pain (e.g., cervical radiculopathy); congenital or acquired deformities of the elbow; surgery of the elbow; dislocation, tendon ruptures, or fractures in the elbow area in the preceding 12 months; systemic musculoskeletal disorders; and neurological disorders. There were small differences in the exclusion criteria between the 2 studies. For example, patients in the study by Hay, *et al*<sup>16</sup> were excluded if they had consulted their GP for elbow pain during the preceding 12 months, whereas patients in the study of Smidt, *et al*<sup>17</sup> were only excluded if they had been treated for elbow complaints with physiotherapy or injection(s) in the previous 6 months. In addition, patients with bilateral elbow symptoms and patients who had elbow complaints shorter than 6 weeks were excluded from the latter study<sup>17</sup>.

**Prognostic indicators and outcome assessment.** At baseline, patients completed questionnaires containing items on potential prognostic indicators. Based on history, the following indicators were taken into consideration: gender, age, duration of elbow complaints, concomitant neck pain, concomitant shoulder pain, previous elbow complaints, involvement of the dominant side, social class (high, middle, low, unemployed), work (manual work, non-manual work, unemployed), and baseline pain severity. Severity of pain during the day was measured using a numeric rating scale in both studies and assessed at baseline and during 3 followup visits at one month (4 weeks in Hay's study<sup>16</sup> and 6 weeks in Smidt's study<sup>17</sup>) and at 6 and 12 months. Pain scores were transformed to a 0-100-point scale: higher scores indicated more pain.

**Statistical analysis.** Data analysis was based on individual patient data from both RCT and was carried out using SPSS<sup>19</sup>.

Univariate linear regression analysis was used to investigate associations between potential prognostic indicators and pain scores at 1, 6, and 12 month followup. The variables "study" (Hay<sup>16</sup> vs Smidt<sup>17</sup>) and "treatment" were always included in the model as covariates. Treatment variables were categorized as injections (n = 115), physiotherapy (n = 64), or wait-and-see policy with or without medication (i.e., naproxen, placebo tablets) (n = 170).

Interaction between study and treatment, between study and each potential prognostic variable, and between treatment and each potential prognostic variable was evaluated to test differences in prognostic variables between treatment groups and study populations. Interaction terms were retained in the model if they were significantly associated with outcome ( $p < 0.10$ ).

Stepwise multivariate linear regression analysis, with backward elimination ( $p < 0.10$ ), was used to investigate associations between potential prognostic indicators and pain scores at 1, 6 and 12 month followup.

Data are presented as unstandardized regression coefficients (B) with 95% confidence intervals (CI), and p values. The percentage of explained variance (adjusted R<sup>2</sup>) was calculated to give an indication of the predictive power of the final models.

## RESULTS

**Baseline characteristics and outcome values.** A total of 349 patients with lateral epicondylitis were included in our prospective study. Socio-demographic characteristics, clinical characteristics, and pain intensity at baseline are summarized in Table 1.

**Clinical course of lateral epicondylitis.** Figure 1 presents the clinical course of the severity of pain during the day in

**Table 1.** Patient characteristics, prognostic indicators, and assessment at baseline. Values are numbers of patients (percentages) unless otherwise indicated. Scores are transformed into scores between 0–100; 100 indicates very severe pain.

	Study Population (n = 349) n (%)
<b>Socio-demographic characteristics</b>	
Country of residence	
Netherlands	185 (53)
UK	164 (47)
Mean ( $\pm$ SD) <sup>†</sup> age, yrs	48 ( $\pm$ 9)
Females	171 (49)
<b>Social class (based on occupation)</b>	
High (I and II)	67 (19)
Middle (III)	120 (34)
Low (IV and V)	60 (17)
Unemployed (retired, sick leave, housewife)	102 (29)
<b>Work</b>	
Manual work	119 (34)
Non-manual work	128 (37)
No work	102 (29)
<b>Clinical characteristics</b>	
Mean ( $\pm$ SD) duration of elbow complaints, wks	15 ( $\pm$ 22)
Duration	
< 3 mo	244 (70)
3–6 mo	73 (21)
> 6 mo	32 (9)
Involvement of the dominant side	245 (70)
Concomitant neck pain according to patient	75 (22)
Concomitant shoulder pain according to patient	77 (22)
Previous elbow complaints	90 (26)
<b>Allocated interventions in RCT</b>	
Corticosteroid injections	115 (33)
Wait-and-see policy (with or without medication)	170 (49)
Physiotherapy	64 (18)
<b>Baseline measures</b>	
Mean ( $\pm$ SD) severity of pain during the day	55.3 ( $\pm$ 22.6)

SD: standard deviation; RCT: randomized controlled trial.

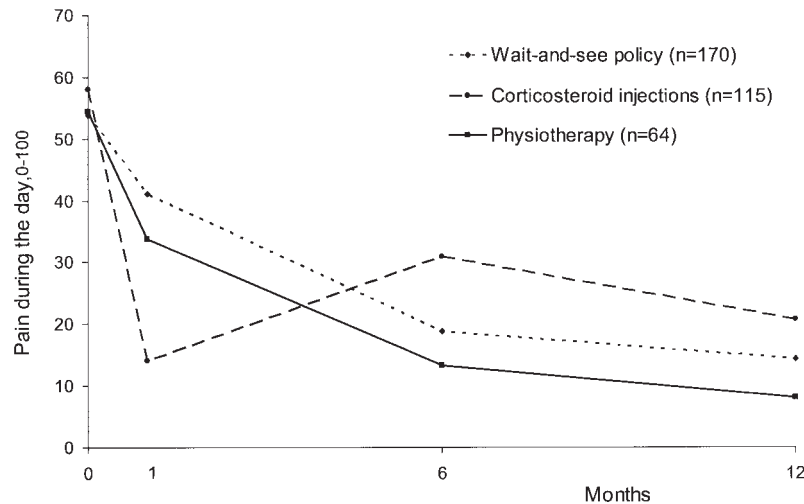


Figure 1. Course of lateral epicondylitis in primary care.

patients with lateral epicondylitis in general practice for each intervention separately. In Smidt's study<sup>17</sup>, one patient in the injection group withdrew after 1 month of followup. Pain scores of 6, 4, and 7 patients in Hay's study<sup>16</sup> were missing at 1, 6, and 12 month followup, respectively. After 12 month followup, a decrease in pain during the day was found for almost all patients (89%) regardless of treatment. After 1 month a large decrease in pain was found for patients treated with corticosteroid injection(s) (n = 115), but relapses or recurrences were common after 6 and 12 month followup. Patients treated with physiotherapy, naproxen, placebo tablets, or a wait-and-see policy showed similar course of pain during the 1 year followup.

**Prognostic indicators of outcome at 1 month.** The association between prognostic indicators and pain scores at 1 month for 349 patients with lateral epicondylitis is presented in Table 2.

Univariable linear regression analyses, adjusted for study and treatment, showed that age, gender, duration of elbow pain, concomitant shoulder pain, social class, and pain intensity at baseline were all associated ( $p < 0.10$ ) with higher pain scores at 1 month. In the multivariable linear regression analyses, severe elbow complaints at baseline, long duration of elbow pain, and concomitant shoulder pain were still associated with higher pain scores and explained 33% of the total variability of pain scores at 1 month. The model predicts that, for example, if the duration of elbow pain and baseline pain scores were identical for all patients, patients with concomitant shoulder pain would have a pain score on average 5.7 points higher at one month followup than patients without concomitant shoulder pain.

We found a significant interaction between study and symptom duration. This indicated that a long duration of elbow complaints was associated with higher pain scores at 1 month followup in the Dutch study, while the opposite was found for the English population, with a long duration of

elbow complaints being associated with lower pain scores at 1 month followup (on average 0.3 points less pain per week on a scale of 0-100)<sup>16</sup>.

**Prognostic indicators of outcome at 6 months.** Results of the uni- and multivariate regression analysis for the pain scores at 6 month followup are shown in Table 3.

Multivariable analyses show that a long duration of elbow complaints and severe pain at baseline were associated with higher pain scores at 6 month followup. In addition, we found that manual workers had lower pain scores at 6 months than non-manual workers. However, this was not similar in both studies. In Hay's study<sup>16</sup>, manual work was associated with higher pain scores at 6 month followup whereas in Smidt's study<sup>17</sup> manual work was associated with lower pain scores (compared to non-manual work). Furthermore, the positive association between severe pain at baseline and pain scores at 6 month followup was stronger in Smidt's<sup>17</sup> than in Hay's study<sup>16</sup>.

**Prognostic indicators of outcome at 1 year.** The association between prognostic indicators and pain scores at 12 month followup is shown in Table 4. Results of multivariable regression analyses showed that a long duration of elbow complaints, concomitant neck pain, and severe pain at baseline were associated with higher pain scores at longterm followup. Patients from higher social classes reported lower pain scores at 12 month followup than patients from lower social classes. Other potential prognostic indicators, such as age, gender, previous episodes, and involvement of the dominant side were not related to outcome at 1 and 12 month followup. Interaction between treatment and severity of pain at baseline was statistically significant, which indicates that different associations were found between baseline pain intensity and pain scores at 12 months in the 3 treatment groups. Patients who had received physiotherapy and reported higher baseline



**Table 2.** Prognostic indicators of severity of pain during the day: uni- and multivariable linear regression analyses of outcome at 1 month (n = 349). Univariable linear regression analyses are adjusted for study and treatment; interactions between prognostic variables and treatment versus prognostic variables and study with  $p < 0.10$  are presented. Multivariable linear regression analyses are adjusted for study and treatment.

Co-variables	Univariable Linear Regression Analyses		Multivariable Linear Regression Analyses (without interactions)		Multivariable Linear Regression Analyses (including interaction)	
	$\beta$ (95% CI)	p	$\beta$ (95% CI)	p	$\beta$ (95% CI)	p
Intercept			18.7 (11.3, 26.0)	< 0.01	17.9 (10.6, 25.2)	< 0.01
Study (ref: Smidt <sup>17</sup> )	8.7 (3.3, 14.2)	< 0.01	6.3 (1.0, 11.6)	0.02	11.4 (5.2, 17.5)	< 0.01
Treatment (ref: medication)						
Injection	-27.2 (-32.7, -21.6)	< 0.01	-27.3 (-32.7, -21.9)	< 0.01	-27.4 (-32.7, -22.0)	< 0.01
Physiotherapy	-7.4 (-14.0, -0.7)	0.03	-3.3 (-10.5, 3.9)	0.37	-3.7 (-10.8, 3.4)	0.30
Prognostic indicators						
Age, per yr	-0.4 (-0.8, 0.02)	0.07				
Interaction treatment injection $\times$ age	0.4 (-0.3, 1.0)	0.25				
Interaction treatment physiotherapy $\times$ age	0.8 (0.1, 1.6)	0.03				
Female gender	4.0 (-0.8, 8.9)	0.10				
Duration of elbow pain, per wk	0.1 (0.0, 0.2)	0.04	0.04 (-0.06, 0.1)	0.45	0.1 (0.01, 0.2)	0.04
Interaction study $\times$ duration	-4.4 (-0.7, -0.2)	< 0.01			-0.4 (-0.6, -0.1)	< 0.01
Involvement of dominant side	3.2 (-2.3, 8.8)	0.25				
Concomitant neck pain according patient	3.7 (-2.3, 9.6)	0.23				
Concomitant shoulder pain according patient	5.7 (-0.2, 11.6)	0.06	4.7 (-0.9, 10.3)	0.10	5.7 (0.1, 11.3)	0.05
Previous episodes	2.4 (-3.2, 7.9)	0.41				
Social class (ref: low social class)						
High	-5.5 (-13.6, 2.6)	0.18				
Middle	-6.6 (-13.8, 0.6)	0.07				
Unemployed	-4.7 (-12.1, 2.8)	0.22				
Work (ref: non-manual work)						
Manual work	4.7 (-1.2, 10.6)	0.12				
Unemployed	2.3 (-3.7, 8.3)	0.46				
Severity of pain during the day (0–100) (per point)	0.3 (0.2, 0.4)	< 0.01	0.3 (0.2, 0.4)	< 0.01	0.3 (0.2, 0.4)	< 0.01
Adjusted R <sup>2</sup> (%)			30%		33%	

$\beta$ : unstandardized regression coefficient;  $\beta$  positive: more pain per unit potential prognostic indicator;  $\beta$  negative: less pain per unit potential prognostic indicator; 95% CI: 95% confidence interval; ref: reference group; Adjusted R<sup>2</sup> (%): the proportion of the total variance explained by the final model.

pain scores had better outcomes (lower pain scores) at followup. In contrast, in patients who received steroid injection or a wait-and-see policy, with or without medication, high baseline scores were associated with poor outcomes ( $p < 0.05$ ).

## DISCUSSION

Our prospective followup study evaluated the clinical course of lateral epicondylitis in general practice and investigated prognostic indicators of outcome. Included were 349 patients who consulted their GP for lateral epicondylitis and consented to participate in 2 RCT that compared different treatment modalities.

In the literature, lateral epicondylitis is often described as a self-limiting-condition<sup>7,20</sup>. Based on our study, we can confirm this statement, as almost all patients (89%) reported improvement in pain at 1 year. However, we also found that the prognosis of lateral epicondylitis at 1 year followup in our combined dataset is strongly influenced by duration of elbow complaints, concomitant neck pain, and severity of pain on the day of presentation. High baseline pain scores consistently predicted poor outcome at all 3 time points in our study, and other studies investigating the prognosis of lateral epicondylitis

in general practice have also reported that high baseline pain scores are a strong predictor of poor outcome<sup>14,15,21</sup>. Other factors such as concomitant shoulder pain appear to have more influence on early than longterm outcome. Overall we found that patients from higher social classes reported lower pain scores at 1 year followup than patients from lower social classes. Since social class was measured by occupation, the explanation might be that higher social classes have less exposure to physical stress on the elbow at work following treatment. However we separately categorized the cohort into manual and non-manual workers, and there was no overall effect of manual work on outcome at 12 months, in contrast to the findings of Haahr and Anderson<sup>14</sup>. In the short term, evidence for an effect of manual work on poor outcome was conflicting, with better outcomes in manual workers at 6 months in The Netherlands and worse outcomes in the UK, the latter previously reported by Lewis, *et al*<sup>15</sup>. It is possible therefore that aspects of social class other than occupational activity, such as different opportunities to rest the elbow or train extensor muscles, may explain the effect of social class on longterm outcome, and that differences in cultural and social environment, such as the systems of disability payment, may explain the contrasting effect of manual work between The

**Table 3.** Prognostic indicators of severity of pain during the day: uni- and multivariable linear regression analyses of outcome at 6 months (n = 349). Univariable linear regression analyses are adjusted for study and treatment; interactions between prognostic variables and treatment versus prognostic variables and study with  $p < 0.10$  are presented. Multivariable linear regression analyses are adjusted for study and treatment.

Co-variables	Univariable Linear Regression Analyses		Multivariable Linear Regression Analyses (without interactions)		Multivariable Linear Regression Analyses (including interaction)	
	B (95% CI)	p	B (95% CI)	p	B (95% CI)	p
Intercept			2.9 (−5.6, 11.5)	0.50	−1.6 (−15.7, 12.5)	0.82
Study (ref: Smidt <sup>17</sup> )	3.6 (−1.9, 9.0)	0.20	0.8 (−5.2, 6.8)	0.80	10.7 (−5.4, 26.9)	0.19
Treatment (ref: medication)						
Injection	12.2 (6.2, 18.2)	< 0.01	10.8 (4.8, 16.8)	< 0.01	−3.0 (−18.7, 12.6)	0.70
Physiotherapy	−5.5 (−12.7, 1.6)	0.13	−5.8 (−13.8, 2.1)	0.15	6.2 (−14.6, 27.1)	0.56
Prognostic indicators						
Age, per yr	−0.3 (−0.5, 0.03)	0.09				
Female gender	2.2 (−3.1, 7.5)	0.41				
Duration of elbow pain, per wk	0.2 (0.03, 0.3)	0.01	0.1 (0.01, 0.2)	0.03	0.1 (0.01, 0.2)	0.04
Interaction study × duration	−0.2 (−0.5, 0.05)	0.11				
Involvement of dominant side	0.0 (−6.0, 6.0)	0.99				
Concomitant neck pain according patient	−0.8 (−7.3, 5.7)	0.81				
Concomitant shoulder pain according patient	−4.7 (−11.2, 1.7)	0.15				
Previous episodes	4.9 (−1.2, 10.9)	0.12				
Social class (ref: low social class)						
High	−3.7 (−12.7, 5.2)	0.41				
Middle	−1.2 (−9.1, 6.8)	0.78				
Unemployed	−6.6 (−14.8, 1.7)	0.12				
Work (ref: non-manual work)						
Manual work	−7.1 (−16.2, 1.9)	0.12	1.9 (−4.4, 8.2)	0.55	−8.7 (−17.5, 0.1)	0.05
Unemployed	−8.0 (−16.2, 0.3)	0.06	−3.1 (−9.5, 3.2)	0.33	−6.3 (−14.2, 1.6)	0.12
Interaction study × manual work	22.0 (9.3, 34.7)	< 0.01			22.2 (9.8, 34.5)	< 0.01
Interaction study × unemployed	12.4 (−0.8, 25.6)	0.07			8.9 (−3.9, 21.6)	0.17
Severity of pain during the day (0–100) (per point)	0.4 (0.2, 0.6)	< 0.01	0.3 (0.1, 0.4)	< 0.01	0.4 (0.2, 0.6)	< 0.01
Interaction treatment injection × severity of pain during the day	0.3 (0.01, 0.5)	0.06			0.2 (−0.03, 0.5)	0.08
Interaction treatment physiotherapy × severity of pain during the day	−0.3 (−0.6, 0.1)	0.18			−0.2 (−0.6, 0.1)	0.22
Interaction study × severity of pain during the day	−0.3 (−0.6, −0.06)	0.01			−0.4 (−0.6, −0.1)	< 0.01
Adjusted R <sup>2</sup> (%)			12%		20%	

For definitions see Table 2.

Netherlands and the UK.

The most consistent prognostic indicators of outcome generally in musculoskeletal disorders are severe pain intensity presenting at baseline and a long duration of complaints<sup>21–24</sup>. Our results corroborate this and add to evidence that variables such as severity and duration of pain play an important role in the prognosis of many musculoskeletal disorders, regardless of the location of the problem<sup>25</sup>.

Pooling data from 2 RCT increased the predictive power of our study. However, the combination of prognostic variables, including the covariates country and treatment, explained only 30% (1 month) and 12% (12 months) of the variance in pain intensity. In this study, the number of prognostic variables was limited because the 2 studies either did not measure the same demographic variables or did not measure them in the same way. Furthermore, other prognostic variables not included in these 2 trials, such as work-related and psychosocial factors (for example, coping strategies), may also play an important role<sup>14,21</sup>.

The Dutch College of General Practitioners recommends

in their guidelines for epicondylitis a wait-and-see policy, with prescription of paracetamol or NSAID if necessary<sup>26</sup>. For patients with persistent, severe complaints of lateral epicondylitis, the guidelines recommend corticosteroid injections as an alternative treatment<sup>26</sup>. Figure 1 illustrates the effectiveness of corticosteroid injection in providing early pain relief. However, at 12 month followup, our patients with severe elbow complaints who had received physiotherapy had larger reductions in pain than those treated with steroid injection(s). Therefore, these longterm results should be taken into account when the Dutch guidelines for epicondylitis are updated. Clinical prediction rules could be developed using data like ours, but information regarding other important predictors would be needed, including comorbidities such as fibromyalgia as well as work-related and psychosocial factors that were not included here<sup>27</sup>.

A strength of our analysis was that it drew on 2 studies conducted independently in different national health care settings. However such a combination of studies could contribute more to the optimum treatment of patients with lateral epicondylitis.

**Table 4.** Prognostic indicators of severity of pain during the day: uni- and multivariable linear regression analyses of outcome at 12 months (n = 349). Univariable linear regression analyses are adjusted for study and treatment; interactions between prognostic variables and treatment versus prognostic variables and study with  $p < 0.10$  are presented. Multivariable linear regression analyses are adjusted for study and treatment.

Co-variables	Univariable Linear Regression Analyses		Multivariable Linear Regression Analyses (without interactions)		Multivariable Linear Regression Analyses (including interaction)	
	$\beta$ (95% CI)	p	$\beta$ (95% CI)	p	$\beta$ (95% CI)	p
Intercept			5.8 (−4.1, 15.7)	0.25	5.6 (−5.7, 16.9)	0.33
Study (ref: Smidt <sup>17</sup> )	2.3 (−2.6, 7.3)	0.35	−1.2 (−6.6, 4.3)	0.67	−1.4 (−6.8, 4.0)	0.61
Treatment (ref: medication)						
Injection	6.5 (1.1, 12.0)	0.02	4.9 (−0.6, 10.4)	0.08	−2.8 (−17.2, 11.6)	0.70
Physiotherapy	−6.2 (−12.8, 0.4)	0.07	−6.9 (−14.2, 0.5)	0.07	11.1 (−6.2, 28.5)	0.21
Prognostic indicators						
Age, per yr	−0.1 (−0.4, 0.2)	0.41				
Female gender	4.8 (−0.1, 9.6)	0.05				
Duration of elbow pain, per wk	0.1 (−0.01, 0.2)	0.08	0.1 (0.02, 0.23)	0.03	0.1 (0.02, 0.2)	0.02
Involvement of dominant side	1.0 (−4.4, 6.5)	0.71				
Concomitant neck pain according patient	9.4 (3.6, 15.2)	< 0.01	9.1 (3.4, 14.8)	< 0.01	9.3 (3.6, 15.0)	< 0.01
Concomitant shoulder pain according patient	0.4 (−5.5, 6.3)	0.90				
Previous episodes	4.6 (−1.0, 10.1)	0.11				
Social class (ref: low social class)						
High	−12.2 (−20.3, −4.1)	< 0.01	−10.4 (−18.4, −2.4)	0.01	−10.9 (−18.9, −3.0)	< 0.01
Middle	−3.4 (−10.6, 3.9)	0.36	−3.3 (−10.3, 3.8)	0.37	−3.9 (−10.9, 3.1)	0.28
Unemployed	−3.9 (11.4, 3.6)	0.31	−3.6 (−11.0, 3.8)	0.34	−4.2 (−11.5, 3.1)	0.26
Work (ref: non-manual work)						
Manual work	0.7 (−5.2, 6.6)	0.81				
Unemployed	1.6 (−4.4, 7.6)	0.60				
Severity of pain during the day (0–100) (per point)	0.3 (0.1, 0.5)	< 0.01	0.2 (0.1, 0.3)	< 0.01	0.2 (0.05, 0.3)	< 0.01
Interaction treatment injection × severity of pain during the day	0.1 (−0.1, 0.4)	0.26			0.1 (−0.1, 0.4)	0.28
Interaction treatment physiotherapy × severity of pain during the day	−0.4 (−0.7, −0.1)	0.02			−0.3 (−0.6, −0.04)	0.03
Interaction study × severity of pain during the day	−0.2 (−0.4, 0.1)	0.12				
Adjusted R <sup>2</sup> (%)			11%		15%	

For definitions see Table 2.

tis, for example in characterizing subgroups that might benefit from selected and targeted treatments, if a standard set of outcome measures and standard questionnaires for patients with lateral epicondylitis were used.

## REFERENCES

- Bot SDM, Van der Waal JM, Van der Windt DAWM, Schellevis FG, Bouter LM, Dekker J. Incidence and prevalence of complaints of the neck and upper extremity in general practice. *Ann Rheum Dis* 2005;64:118–23.
- Hamilton PG. The prevalence of humeral epicondylitis: a survey in general practice. *J R Coll Gen Pract* 1986;36:464–5.
- Miedema HS. Rheumatology research (ROME): an initial report [In Dutch: Reuma-onderzoek meedere echelons: Basisrapport]. Leiden: Nederlands Instituut voor Praeventieve Gezondheidszorg TNO; 1994.
- Verhaar JAN. Tennis elbow [thesis]. Maastricht: University Press, 1992.
- Binder AI, Hazleman BL. Lateral humeral epicondylitis – a study of natural history and the effect of conservative therapy. *Br J Rheumatol* 1983;22:73–6.
- Goldie I. Local steroid therapy in painful orthopedic conditions. *Scott Med J* 1972;17:176–86.
- Cyriax JH. The pathology and treatment of tennis elbow. *J Bone Joint Surg* 1936;18:921–38.
- Hudak PL, Cole D, Haines T. Understanding prognosis to improve rehabilitation: the example of lateral elbow pain. *Arch Phys Med Rehabil* 1996;77:586–93.
- Murtagh JE. Tennis elbow. *Aust Fam Physician* 1988;17:90,91,94–5.
- Burton AK. A comparative trial of forearm strap and topical anti-inflammatory as adjuncts to manipulative therapy in tennis elbow. *Manual Med* 1988;3:141–3.
- Nevelos AB. The treatment of tennis elbow with triamcinolone acetate. *Curr Med Res Opin* 1980;6:507–9.
- Schapira D, Linn S, Scharf Y. A placebo-controlled evaluation of diclofenac diethylamine salt in the treatment of lateral epicondylitis of the elbow. *Curr Ther Res* 1991;49:162–8.
- Stratford PW, Levy DR, Gaudie S, Miseferi D, Levy K. The evaluation of phonophoresis and friction massage as treatments for extensor carpi radialis tendinitis: a randomised controlled trial. *Physiother Canada* 1989;41:93–9.
- Haahr JP, Anderssen JH. Prognostic factors in lateral epicondylitis: a randomized trial with one-year follow-up in 266 new cases treated with minimal occupational intervention or the usual approach in general practice. *Rheumatology Oxford* 2003;42:1216–25.
- Lewis M, Hay EM, Paterson SM, Croft P. A longitudinal study of the effects of manual work on recovery from lateral epicondylitis. *Scand J Work Environ Health* 2002;28:109–16.
- Hay EM, Paterson SM, Lewis M, Hosie G, Croft P. Pragmatic



- randomised controlled trial of local corticosteroid injection and naproxen for treatment of lateral epicondylitis of elbow in primary care. *BMJ* 1999;319:964-8.
17. Smidt N, Van der Windt DAWM, Assendelft WJJ, Devillé WLJM, Korthals-de Bos IBC, Bouter LM. Corticosteroid injections, physiotherapy, or a wait-and-see policy for lateral epicondylitis: a randomised controlled trial. *Lancet* 2002;359:657-62.
  18. Smidt N, Lewis MA, Hay EM, Van der Windt DA, Bouter LM, Croft P. A comparison of two primary care trials on tennis elbow: issues of external validity. *Ann Rheum Dis* 2005;64:1406-9.
  19. SPSS for Windows, release 11.0. Chicago: SPSS, 2001.
  20. Kivi P. The aetiology and conservative treatment of humeral epicondylitis. *Scand J Rehabil Med* 1982;15:37-41.
  21. Bot SDM, Van der Waal JM, Van der Windt DAWM, Bouter LM, Dekker J. Course and prognosis of elbow complaints: a cohort study in general practice. *Ann Rheum Dis* 2005;64:1331-6.
  22. Kuijpers T, Van der Windt DAWM, Van der Heijden GJM, Bouter LM. Systematic review of prognostic cohort studies on shoulder disorders. *Pain* 2004;109:420-31.
  23. Klenerman L, Slade PD, Stanley IM, et al. The prediction of chronicity in patients with acute attack of low back pain in a general practice setting. *Spine* 1995;20:478-84.
  24. Karjalainen K, Malmivaara A, Mutanen P, Pohjolainen T, Roine R, Hurri H. Outcome determinants of subacute low back pain. *Spine* 2003;28:2634-40.
  25. Croft P. Is life becoming more of a pain? People may be getting more willing to report pain. *BMJ* 2000;320:1552-3.
  26. Assendelft WJ, Rikken SA, Mel M, et al. NHG-standaard epicondylitis. *Huisarts Wet* 1997;40:21-6.
  27. Laupacis A, Sekar N, Stiell IG. Clinical prediction rules. A review and suggested modifications of methodological standards. *JAMA* 1997;277:488-94.